JP06-256926

CLAIMS

[Claim(s)]

[Claim 1] Thermal-barrier-coating film characterized by consisting of a ceramic layer which is the cascade screen which it comes to prepare on a base material front face by carrying out sequential adhesion, and is rich in the high metal layer, the middle class who is precise and does not have oxygen conductivity, and thermal insulation nature of anticorrosion and oxidation resistance from a base material side.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the thermal-barrier-coating film especially applied in favor of turbine **, stationary blade, and combustor (the container liner, tail pipe) of a gas turbine about the thermal-barrier-coating film.

[0002]

[Description of the Prior Art] The thermal-barrier-coating film for gas turbine elevated-temperature components (a turbine bucket and a stationary blade, combustor) by the conventional technique has structure as shown in drawing 2 and drawing 3 . That is, as are shown in drawing 2 , and the laminating of the metal layer 2 and the ceramic layer 4 is carried out to the base material 1 or it is shown in drawing 3 , it is the multilayer structure by which the metal layer 2, the metal-ceramic mixolimnion 5, and the ceramic layer 4 were formed in the base material 1. The outermost layer consists of a ceramic layer 4 also in which thermal-barrier-coating film.

[0003] In such thermal barrier coating, the metal layer 2 is for mainly making small the difference of the coefficient of thermal expansion of a base material 1, the ceramic layer 4, or the base material 1 and the metal ceramic mixolimnion 5, and this aiming at relaxation of thermal stress, and preventing exfoliation of the ceramic layer 4. Moreover, the role rate of the metal layer 2 is aimed at much more positively also about the metal-ceramic mixolimnion 5. In addition, generally the MCrAlY alloy system (element more than kinds, such as M:nickel, and Co, Fe) excellent in the anticorrosion and the oxidation resistance in an elevated temperature is used for this metal layer 2.

Moreover, for the purpose of thermal insulation, thermal conductivity is low and the ceramic layer 4 is ZrO2 with high emissivity. System ceramics (ZrO2, MgO, ZrO2, Y2 O3, etc.) is mainly used.

[0004]

[Problem(s) to be Solved by the Invention] As for the gas turbine, elevated-temperature-ization of a turbine inlet gas temperature is progressing in recent years for efficient-izing. In connection with this, since the thermal-barrier-coating film is very effective in metal-temperature reduction of the elevated-temperature components of a gas turbine, also in gas turbine elevated-temperature components, it is applied to the turbine stationary blade severe in a service condition and combustor tail pipe other than a combustor container liner, and application to those with **** and a turbine bucket with a service condition severe further more is expected.

[0005] As a damage gestalt of thermal barrier coating, the differential thermal expansion of the configuration layer of ** thermal barrier coating, and a base material, Exfoliation of the ceramic layer by the thermal stress resulting from a temperature gradient and ** metal layer are oxygen (generally a ceramic layer is porous). It expands by oxidation resulting from being exposed to an elevated temperature under the oxygen existence which has passed this. There are corrosion of exfoliation near the ceramic layer of a metal layer, the metal layer by ** corrosive components (S, Na, V, etc.), and a ceramic layer and consumption of the ceramic layer by the erosion resulting from ** coming-flying particle. The damage gestalt of the thermal barrier coating from which the thermal load which thermal barrier coating receives becomes high much more, and poses a problem most with elevated-temperature-izing of a turbine inlet gas temperature is above-mentioned **. although the metal layer excellent in oxidation resistance is used, in order that [namely,] it may be exposed more to an elevated temperature under oxygen existence and a metal layer may oxidize — this — exfoliation of a ceramic layer — a ream — the life of ** and thermal barrier coating — short — **** — flume ****** arises.

[0006] This invention tends to offer the thermal-barrier-coating film which solves this problem in view of an above-mentioned situation.

[0007]

[Means for Solving the Problem] This invention is a cascade screen which it comes to prepare on a base material front face by carrying out sequential adhesion, and it is the thermal-barrier-coating film characterized by consisting of a ceramic layer which is rich in anticorrosion, an oxidation-resistant high metal layer, the middle class that is

precise and does not have oxygen conductivity, and thermal insulation nature from a base material side.

[0008] In this invention as a high metal layer of anticorrosion and oxidation resistance MCrAlY (element more than kinds, such as Y:nickel, and Co, Fe) It is precise and a coefficient of thermal expansion is the middle thing of said metal layer and the ceramic layer which is rich in the after-mentioned thermal insulation nature as an interlayer without oxygen conductivity. MgO, CaO, CeO2, and aluminum 2O3 etc. — moreover — as the ceramic layer which is rich in thermal insulation nature — ZrO2, MgO, ZrO2 and Y2 O3, ZrO2, and CeO2 etc. — ZrO2 The system ceramics is used.

[0009]

[Function] Since the interlayer who prevents invasion of oxygen exists in the middle, a metal layer does not oxidize, and exfoliation of the ceramic layer of the outermost layer does not produce the thermal-barrier-coating film of this invention, but the life of the thermal-barrier-coating film becomes long.

[0010]

[Example] Drawing 1 R> 1 explains one example of the thermal-barrier-coating film of this invention. As shown in drawing 1 , it has the multilayer structure by which the laminating of the high metal layer 2 of anticorrosion and oxidation resistance, the interlayer 3 who prevents invasion of oxygen, and the ceramic layer 4 with a thermal insulation property high as an outermost layer was carried out in order on the base material 1.

[0011] In the thermal-spraying material for the metal layers 2, it is ZrO 2-8Y2O3 to the thermal-spraying material for ceramic layer 4 about CoNiCrAlY (Co-32nickel-21Cr-3aluminum-0.5Y). It used and MgO or aluminum 2O3 was used for the thermal-spraying material or coating material for middle class 3.

[0012] Four kinds of test specimens shown in Table 1 were produced using above-mentioned thermal-spraying material or an above-mentioned coating material. First, sample It is aluminum 2O3 about the front face of the heat-resistant alloy (Co radical alloy: 30x50x3mmt) which is a base material 1 in No.1. Grid blast processing was performed with the grain and the heat-resistant-alloy front face was changed into the condition of having been suitable for the plasma metal spray. Next, thermal spraying of the high metal layer of anticorrosion and oxidation resistance was carried out by the low voltage plasma metal spray method. Moreover, the middle class was coated with electron beam physical vapor deposition, and thermal spraying of the ceramic layer was carried out to the last by the atmospheric-air plasma metal spray approach. Sample Except for having carried out thermal spraying of the interlayer by

the low voltage plasma metal spray method in No.2 The test specimen was produced in the same way as No.1. Sample Except for having changed an interlayer's quality of the material in No.3 The test specimen was produced in the same way as No.1. Sample No.4 are the conventional thermal barrier coating and they were produced in the way same as comparison material as No.1. To the last, it is a sample. In order to raise the bond strength of the thermal barrier coating of No.1– No.4, 1000 degree–Cx 2 hours (heat treatment among a vacuum) were carried out as diffusion heat treatment.

[0013] The oxidation test by heating (1050 degree–Cx 300 hours) among an atmospheric electricity furnace was carried out using the above–mentioned test specimen. It gazed at the cross–section microstructure after heating, and the oxidation resistance of a metal layer was evaluated. Next, the thermal cycling test (repetition between 950 degrees C and 200 degrees C) was carried out about front [heating] material and the material after heating (1050 degree–Cx 300 hours) among an atmospheric electricity furnace. The number of heat cycles until exfoliation of a thermal–barrier–coating layer arises by the thermal cycling test estimated peeling resistance. These test results are shown in Table 2.

[0014] From Table 2, as compared with it of the former [film / of this invention / thermal–barrier–coating], there is little oxidation of a metal layer, and, for this reason, there were many numbers of cycles to exfoliation by the thermal cycling test of heating material, and the effectiveness of the thermal–barrier–coating film of this invention was proved.

[0015]

[Table 1]

No translation

* APS Atmospheric–air plasma metal spray method LPPS Low voltage plasma metal spray method EB–PVD Electron beam physical vapor deposition [0016]

[Table 2]

No translation

[0017]

[Effect of the Invention] Since an interlayer is prepared between a ceramic layer and a metal layer and passage of oxygen is prevented by this interlayer, it is hard to produce oxidization of a metal layer, and the life of thermal–barrier–coating film of this invention of the thermal–barrier–coating film improves. Therefore, a severe operating

environment with more high inlet gas temperature or the gas turbine elevated-temperature components (turbine ** and a stationary blade, a combustor container liner and a tail pipe) which are equal to more nearly prolonged use can be offered by applying the thermal-barrier-coating film by this invention to a gas turbine.

TECHNICAL FIELD

[Industrial Application] This invention relates to the thermal-barrier-coating film especially applied in favor of turbine **, stationary blade, and combustor (the container liner, tail pipe) of a gas turbine about the thermal-barrier-coating film.

PRIOR ART

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OPERATION

[Function] Since the interlayer who prevents invasion of oxygen exists in the middle, a metal layer does not oxidize, and exfoliation of the ceramic layer of the outermost layer does not produce the thermal-barrier-coating film of this invention, but the life of the thermal-barrier-coating film becomes long.

EXAMPLE

[Example] Drawing 1 R> 1 explains one example of the thermal-barrier-coating film of this invention. As shown in drawing 1 , it has the multilayer structure by which the laminating of the high metal layer 2 of anticorrosion and oxidation resistance, the interlayer 3 who prevents invasion of oxygen, and the ceramic layer 4 with a thermal insulation property high as an outermost layer was carried out in order on the base material 1.

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[0015]

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[Table 2]
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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The explanation sectional view of the thermal-barrier-coating film of one example of this invention.
[Drawing 2] The conventional thermal-barrier-coating film is an explanation sectional view [like] 1 voice.
[Drawing 3] The explanation sectional view of other modes of the conventional thermal-barrier-coating film.

DRAWINGS

No translation

(19)日本国特許庁（JP）　(12) 公開特許公報（A）　(11)特許出願公開番号

特開平6－256926

(43)公開日 平成6年(1994) 9月13日

(51)Int.Cl.5		識別記号	庁内整理番号	FI	技術表示箇所
C23C	4/10				
	4/04				
F01D	5/28		7825－3G		
F02C	7/24	A	7910－3G		
F23R	3/42	C	7604－3G		

審査請求 未請求 請求項の数1 OL （全 4 頁）

(21)出願番号　特願平5－46554

(22)出願日　平成5年(1993) 3月8日

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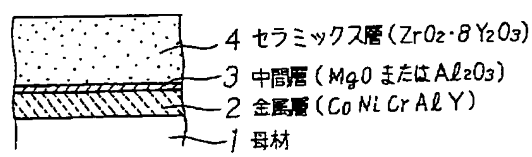
(54)【発明の名称】 遮熱コーティング膜

(57)【要約】
【目的】 高温部品用の遮熱コーティング膜に関する。
【構成】 母材表面上に順次密着して設けられてなる積層膜であって、母材側から耐食・耐酸化性の高い金属層、緻密で酸素導伝性のない中間層及び遮熱性に富むセラミックス層からなる遮熱コーティング膜。



【特許請求の範囲】

【請求項１】　母材表面上に順次密着して設けられてなる積層膜であって、母材側から耐食・耐酸化性の高い金属層、緻密で酸素導伝性のない中間層及び遮熱性に富むセラミックス層からなることを特徴とする遮熱コーティング膜。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は遮熱コーティング膜に関し、特にガスタービンのタービン動・静翼及び燃焼器（内筒，尾筒）に有利に適用される遮熱コーティング膜に関する。

【０００２】

【従来の技術】従来技術によるガスタービン高温部品（タービン動翼・静翼，燃焼器）用遮熱コーティング膜は図２及び図３に示すような構造になっている。すなわち、図２に示すように、母材１に金属層２及びセラミックス層４が積層されているか、あるいは図３に示すように、母材１に金属層２、金属－セラミックス混合層５及びセラミックス層４が形成された多層構造である。何れの遮熱コーティング膜においても最外層はセラミックス層４よりなっている。

【０００３】これらの遮熱コーティングにおいて、金属層２は主に母材１とセラミックス層４あるいは母材１と金属セラミックス混合層５との熱膨張率の差を小さくし、これにより熱応力の緩和を図り、セラミックス層４の剥離を防ぐためのものである。また、金属－セラミックス混合層５についても、金属層２の役割りを一層積極的に狙ったものである。なお、この金属層２には、高温での耐食・耐酸化性に優れたMＣｒＡｌＹ合金系（Ｍ：Ｎｉ，Ｃｏ，Ｆｅなどの一種以上の元素）が一般に使用されている。また、セラミックス層４は遮熱を目的とし、熱伝導率が低く、輻射率の高いZrO_2系セラミックス（$ZrO_2 \cdot MgO$，$ZrO_2 \cdot Y_2O_3$など）が主に使用されている。

【０００４】

【発明が解決しようとする課題】近年ガスタービンは高効率化のため、タービン入口ガス温度の高温化が進んでいる。これに伴ない、遮熱コーティング膜はガスタービンの高温部品のメタル温度低減に非常に有効であるため、燃焼器内筒の他にガスタービン高温部品の中でも使用条件に厳しいタービン静翼、燃焼器尾筒に適用されつゝあり、さらにより使用条件の厳しいタービン動翼への適用が期待されている。

【０００５】遮熱コーティングの損傷形態として、①遮熱コーティングの構成層と母材との熱膨張差、温度差に起因する熱応力によるセラミックス層の剥離、②金属層が酸素（セラミックス層は一般にポーラスであり、これを通過して来た酸素）存在下で高温にさらされることに起因する酸化により膨張し、金属層のセラミックス層近傍での剥離、③腐食性成分（Ｓ，Ｎａ，Ｖなど）による金属層、セラミックス層の腐食、④飛来微粒子に起因するエロージョンによるセラミックス層の損耗がある。タービン入口ガス温度の高温化に伴ない、遮熱コーティングが受ける熱負荷が一段と高くなり、最も問題となる遮熱コーティングの損傷形態は上述の②である。すなわち、耐酸化性に優れた金属層を用いているが、酸素存在下でより高温にさらされ、金属層が酸化するため、これがセラミックス層の剥離に連がり、遮熱コーティングの寿命が短かくなるという問題が生ずる。

【０００６】本発明は上述の事情を鑑み、この問題を解決する遮熱コーティング膜を提供しようとするものである。

【０００７】

【課題を解決するための手段】本発明は母材表面上に順次密着して設けられてなる積層膜であって、母材側から耐食、耐酸化性の高い金属層、緻密で酸素導伝性のない中間層及び遮熱性に富むセラミックス層からなることを特徴とする遮熱コーティング膜である。

【０００８】本発明において、耐食・耐酸化性の高い金属層としてはMＣｒＡｌＹ（Ｙ：Ｎｉ，Ｃｏ，Ｆｅなどの一種以上の元素）が、緻密で酸素導伝性のない中間層としては熱膨張係数が前記金属層と後記の遮熱性に富むセラミックス層の中間のもので、MgO，CaO，CeO_2，Al_2O_3などが、また遮熱性に富むセラミックス層としては$ZrO_2 \cdot MgO$，$ZrO_2 \cdot Y_2O_3$，$ZrO_2 \cdot CeO_2$などのZrO_2系セラミックスが用いられる。

【０００９】

【作用】本発明の遮熱コーティング膜は中間に酸素の侵入を防止する中間層が存在するため金属層が酸化されず、また、最外層のセラミックス層の剥離が生ぜず遮熱コーティング膜の寿命が長くなる。

【００１０】

【実施例】本発明の遮熱コーティング膜の一実施例を図１によって説明する。図１に示すように、母材１の上に順に耐食・耐酸化性の高い金属層２、酸素の侵入を防止する中間層３、最外層として遮熱特性の高いセラミックス層４が積層された多層構造を有している。

【００１１】金属層２用溶射材にはＣｏＮｉＣｒＡｌＹ（Ｃｏ－３２Ｎｉ－２１Ｃｒ－３Ａｌ－０．５Ｙ）を、セラミックス層４用の溶射材には$ZrO_2 \cdot 8Y_2O_3$を用い、中間層３用の溶射材あるいはコーティング材にはMgOあるいはAl_2O_3を用いた。

【００１２】表１に示す４種類の供試材を上述の溶射材あるいはコーティング材を用いて作製した。まず、試料No.１では母材１である耐熱合金（Ｃｏ基合金：３０×５０×３mmt）の表面をAl_2O_3粒でグリッドブラスト処理を施し、耐熱合金表面をプラズマ溶射に適した状態にした。次に、耐食・耐酸化性の高い金属層を低圧プ

ラズマ溶射法により溶射した。その上に、中間層を電子ビーム物理蒸着法によりコーティングし、最後にセラミックス層を大気プラズマ溶射方法により溶射した。試料No.2では、中間層を低圧プラズマ溶射法により溶射した以外は No.1と同じ要領で供試材を作製した。試料No.3では、中間層の材質を変えた以外は No.1と同じ要領で供試材を作製した。試料 No.4は従来の遮熱コーティングであり、比較材として、 No.1と同じ要領で作製した。最後に、試料 No.1～ No.4の遮熱コーティングの付着強度を向上させるために、拡散熱処理として1000℃×2時間（真空中熱処理）を実施した。

【0013】上述の供試材を用いて、大気電気炉中加熱（1050℃×300時間）による酸化試験を実施した。加熱後、断面ミクロ組織を観察し、金属層の耐酸化＊性を評価した。次に、熱サイクル試験（950℃と200℃の間の繰返し）を加熱前材及び大気電気炉中加熱（1050℃×300時間）後材について実施した。耐剥離性は熱サイクル試験により遮熱コーティング層の剥離が生ずるまでの熱サイクル数により評価した。これらの試験結果を表2に示す。

【0014】表2より、本発明の遮熱コーティング膜は従来のそれに比較して金属層の酸化が少ない、また、このため、加熱材の熱サイクル試験による剥離までの繰返し数が多く、本発明の遮熱コーティング膜の効果が立証された。

【0015】

【表1】

表　1

試料 No.	構　成	材　質	施工法*	膜厚(mm)
1（本発明材）	セラミックス層	$ZrO_2 \cdot 8Y_2O_3$	APS	0.3
	中 間 層	MgO	EB・PVD	0.02
	金 属 層	CoNiCrAlY	LPPS	0.1
2（本発明材）	セラミックス層	$ZrO_2 \cdot 8Y_2O_3$	APS	0.3
	中 間 層	MgO	LPPS	0.04
	金 属 層	CoNiCrAlY	LPPS	0.1
3（本発明材）	セラミックス層	$ZrO_2 \cdot 8Y_2O_3$	APS	0.3
	中 間 層	Al_2O_3	EB・PVD	0.02
	金 属 層	CoNiCrAlY	LPPS	0.1
4（比較材）	セラミックス層	$ZrO_2 \cdot 8Y_2O_3$	APS	0.3
	金 属 層	CoNiCrAlY	LPPS	0.1

＊ APS　大気プラズマ溶射法
LPPS　低圧プラズマ溶射法
EB・PVD　電子ビーム物理蒸着法

【0016】

【表2】

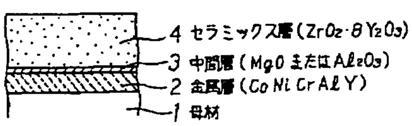
表　2

試料 No. 1	酸化試験	熱サイクル試験	
		加熱前	加熱後
1.（本発明材）	少ない	５００回以上	５００回以上
2.（本発明材）	少ない	５００回以上	５００回以上
3.（本発明材）	少ない	５００回以上	４５０回で剥離
4.（比較材）	多い	５００回以上	２７５回で剥離

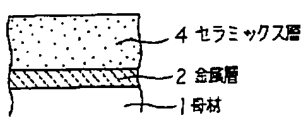
【００１７】
【発明の効果】本発明の遮熱コーティング膜はセラミックス層と金属層との間に中間層を設け、この中間層により酸素の通過が防止されるので、金属層の酸化が生じにくく、遮熱コーティング膜の寿命が向上する。したがって、本発明による遮熱コーティング膜をガスタービンに適用することにより、より入口ガス温度が高い厳しい使用環境、あるいはより長時間の使用に耐えるガスタービン高温部品（タービン動・静翼，燃焼器内筒・尾筒）を提供することができる。

【図面の簡単な説明】
【図１】本発明の一実施例の遮熱コーティング膜の説明断面図。
【図２】従来の遮熱コーティング膜の一態様の説明断面図。
【図３】従来の遮熱コーティング膜の他の態様の説明断面図。

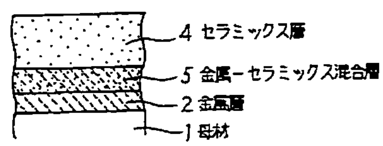
【図１】



【図２】



【図３】



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